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CASE REPORT

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Physical Match: Insole and Shoe

ABSTRACT: In this case report, the authors show an interesting case of a physical match between an insole and a suspect shoe that was connected to the crime scene by a blood drop. Several pairs of shoes were seized and inspected. On the insoles of the main suspect's shoes, two different types of prints were seen, one was clear and the other image was faint. A physical match examination was conducted and the authors could place the right insole inside the right shoe. The insole was apparently glued to the shoe by the sweat, heat and dirt inside the shoe, and not by the manufacturer. In this case, the critical questions were how conclusive can the complexity of the random contours be, and whether the physical match between the two objects could pass the "Daubert challenge."

KEYWORDS: forensic science, physical match, bare feet examination, Daubert challenge

A physical match is a well-known method, often used by forensic experts in order to determine a common origin of two or more fragments of plastic, glass, or other substrates. A physical match is defined by the Association of Firearm and Toolmarks Examiners (AFTE) Standardization Committee as: (1) "the examination of two or more objects, either through physical, optical or photographic means which permits one to conclude either the objects were one entity or were held bonded together in a unique arrangement."

In this case report, the authors show an interesting case of a physical match between an insole and a suspect shoe that was connected to the crime scene by a blood drop. It became necessary to determine which shoe the insole came from.

The examination found a match between the remains of the middle sole and the insole. The matching contour was a very complex line and was about 2 cm (3/4 of an inch) in length.

De Forest et al. wrote: "Physical match that is based on random process that caused the separation of the two objects, one from the other, produces unique surface configuration at the separation line" (2). In this case, the critical questions were how conclusive can the complexity of the random contours be, and whether the physical match between the two objects could pass the Daubert challenge.

The Case

In a murder case, a suspect was apprehended several hours after the murder. The suspect, his father and his older brother were arrested after an eyewitness noted the license plate of the car belonging to the father of the family. During the investigation the policemen obtained from the mother the shoes of her son who was in fact the main suspect.

A blood drop was detected on the right shoe believed to have been worn by the suspect. DNA profiling was completed on the blood and matched that of the victim. This was evidence that the wearer of the shoe was present during the murder at which time a drop of the victim's blood fell on his shoe.

During the trial the defense attorney claimed that there was no evidence that the shoe with the drop of blood belonged to the suspect because the three family members wore the same model of shoes. The prosecution asked the Toolmarks and Materials Laboratory of the DIFS to determine the connection between the suspect's feet and the murderer's shoes.

Examination and Results

The authors from the DIFS received one pair of shoes and one plaster cast of bare feet from each of the three family members.

The comparative examination of the prints made from the suspect's bare feet with the images of the bare foot impressions found on what were believed to be the insoles of the suspected shoes led us to the conclusion that it was possible that the left foot of the suspect made the bare foot image on the left shoe insole. It was then determined that the only conclusion that could be reached for the right insole was that the suspect could not be ruled out from having made the impression. This conclusion was due, in part, to the faint image on the insole.

Sergeant Robert Kennedy from the Royal Canadian Mounted Police (RCMP) Ottawa, Canada, was asked to come to Israel and assist with the barefoot examination in this case. The examination showed that while the insoles appeared identical, the discoloration on the two insoles found inside the suspect's shoes was different. One appeared a little more stained than the other. The authors sus-

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pected that either accidentally or otherwise, someone might have switched insoles from some of the shoes received for examination during the previous examinations.

After laying out all the insoles it was determined that the insole found inside the right shoe of the suspect's brother, which was the same make as that of the suspect's shoe, showed the same discoloration characteristics as the insole found inside the suspect's left shoe. It was assumed at the time that this insole was actually from the suspect's right shoe. After obtaining permission from the courts, the suspect's shoe was cut apart. The bottom of the right insole and the open shoe were photographed (Fig. 1). A physical match examination was conducted to determine if there was any evidence in the original shoe to prove the insole was once part of this shoe.

After the examination, it was concluded that the insole inside the shoe had been glued to the inside layer of the sole sometime during the "life" of the shoe. The insole was apparently glued by the sweat, heat and dirt inside the shoe and not by the manufacturer. When the insole was taken out of the shoe, some parts of the insole had stuck to the shoe. This kind of evidence has a long history of acceptance in courts of law, and even a layperson can conduct numerous experiments in tearing paper, and show that no two pieces tear exactly alike. In forensic literature the physical match is regarded as conclusive evidence, e.g., Kirk (3) wrote that: "when the fragments show a physical fit of a fractured surface, such evidence being so strong as to constitute almost absolute proof."

Other forensic experts emphasize further: "Physical match that is based on random process that caused the separation of the two objects, one from the other, produces unique surface configuration at the separation line" (2). By definition, this random process cannot be reproduced. In the standard procedure of ASTM (4) we find the following: "(#7.5) physical match: the two most specific comparisons that can be made . . . involve the matching of known and questioned sample edges for a physical fit, or matching the surface striae on the underside of a paint fragment to those on the parent surface, or both. This statement assumes that the edges in the questioned exhibit has comparable details such as changes in the fractured direction or that the parent surface exhibits unique striae," which supports the fundamental procedures in forensic science.

In order to meet the Daubert challenge, which has surfaced in many toolmark cases in the U.S. and the U.K., one must show that this evidence, and its interpretation, fulfills all the Daubert requirements. This can be easily demonstrated if we follow Kirk (3) saying that "if an edge match that extends over a reasonable length, e.g., a quarter inch or more can be found, it is virtual proof that the questioned fragment that was broken (conclusive evidence-Y.S) from the exact spot in the original . . .". In our case the physical match extends over almost two centimeters (almost an inch), and its shape is noticeably curved and irregular. Kirk states: "the factors contributing to the probability will be . . . . the shape of the break, e.g. straight or curved, irregularities or striations on the broken surface" (3). This meets the critical criteria demanded by many experts (3–6) in order to establish a conclusive connection between two objects.

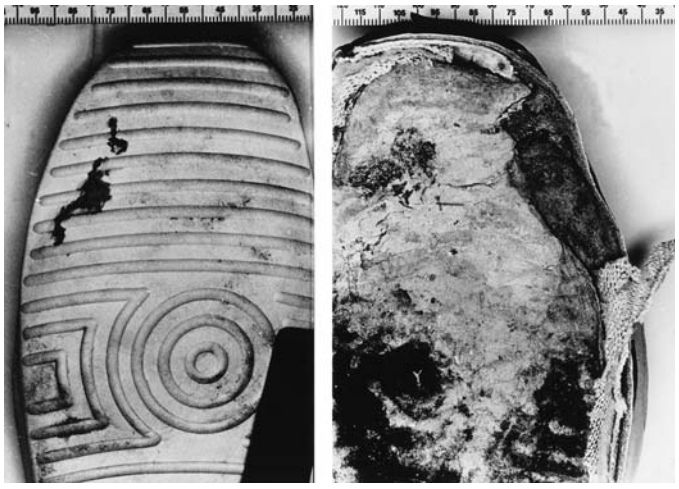

FIG. 1—*The bottom of the right insole (left) and the open shoe (right).*

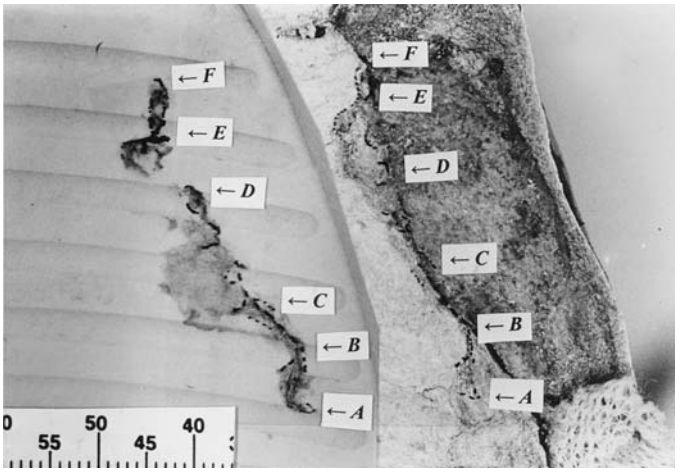

FIG. 2—*Physical match between the bottom of the right insole (left) and the open shoe (right). Side by side examination, the insole (left) is reversed.*

The presence of all these requirements leads us to believe that all four of the criterion demanded by the court (7) are satisfied: the physical match methodology is testable, awareness of known or potential error rate[3], peer review and publications, and general acceptance in the scientific community.

Figure 2 shows traces of the insole that were left on the sole inside the shoe. In addition, the inner part of the shoe belonging to the suspect's brother was stained with some dark colored dust. The same dust appears on the lower part of the insole that was previously found in the suspect's right shoe. The proper insoles for the suspect's shoes were then placed together as a pair and the examination of the bare feet was conducted by the authors according to normal procedure (9).

After the two insoles were finally matched to the proper shoes, it was determined there was a definite need to change the procedure of examining shoes in the DIFS authors' laboratory. In the future, after examining the inner part of the shoes, photographs will be taken of both sides of the insoles found in each shoe. This is a clear example of what can happen to exhibits without proper surveillance and what mix up might occur while the exhibits are out of the expert's sight.

In the case described we were finally able to connect the insole to the person who was wearing the shoe in spite of the mix up of the insoles. In subsequent cases, we will exercise greater caution when dealing with insoles and shoes leaving and being returned to the police unit.

[3] It can be argued that the error rate is indistinct in this case, but this is the case in almost all the toolmarks comparison. The Firearms and Toolmarks field has generated some measure of error rate by participating in the proficiency-testing program developed by the Collaborative Testing Service over the past 20 years (8).

References

1. Glossary of the Association of Firearm and Toolmarks Examination by the AFTE Standardization Committee. 2nd ed. Chicago: Available business forms, 1985.
2. De Forest PR, Gaensslen RE, Lee HC. Forensic Science, An introduction to criminalities. McGraw Hill Book Company, New York 1983;51.
3. Kirk PL. Crime investigation. 2nd ed. New York: John Willey & Sons, 1974;263–64, 301.
4. Standard guide for forensic paint analysis and comparison, E1610-95 (reapproved 2001), ASTM International, West Conshohocken, PA.
5. Faigman DL, Kaye DH, Saks MJ, Sanders J. Modern scientific evidence, the law and science of expert testimony. St. Paul, Minn: West Publishing Co., 1997;2:134–5.
6. Saferstein R. Forensic science handbook. Englewood Cliffs, NJ: Prentice-Hal, Inc. 1982;152–3.
7. *Daubert* vs. *Merrel Dow Pharmaceuticals, Inc*. Supreme Court of the United States, June 1993.
8. Grzybowski RA, Murdock J. Firearms and toolmarks identification—meeting the Daubert challenge. AFTE J 1998;30(1):3–14.
9. Kennedy R. Bare footprint marks. Royal Canadian Mounted Police. Encyclopedia of forensic sciences. Academic Press, London 2000;1189–95.

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